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An Investigation of Mussel Resources in Selected Bayous, Northwestern Mississippi, 1999 and 2000

Andrew C. Miller and Barry S. Payne

August 2001

Environmental Laboratory

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An Investigation of Mussel Resources in Selected Bayous, Northwestern Mississippi, 1999 and 2000

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Final report

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Preface

This report summarizes results of a mussel survey in Cassidy, Hopson, Moore, and Opossum Bayous in northwestern Mississippi, 1999 and 2000. The survey was conducted for the U.S. Army Engineer District, Vicksburg, to assess effects of maintenance dredging. Assistance in the field was provided by Mr. Will Green, University of Southern Mississippi, Hattiesburg, MS, and Ms. Kathryn Barko, University of Wisconsin at Stevens Point, WI. Maps and background information on the project area were provided by Mr. Wendell King, Environmental Analysis Branch, Planning Division, Vicksburg District.

During the conduct of this study, Dr. John W. Keeley was Acting Director, Environmental Laboratory (EL), Vicksburg, MS, U.S. Army Engineer Research and Development Center (ERDC); Dr. C. J. Kirby was Chief, Ecological Research Division, EL; and Dr. Edwin A. Theriot was Chief of the Aquatic Ecology Branch.

At the time of publication of this report, Dr. James R. Houston was Director of ERDC, and COL John W. Morris III, EN, was Commander and Executive Director.

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1 Introduction

Background

The U.S. Army Engineer District, Vicksburg, is tasked with maintaining bayous, small streams, and rivers in northwestern Mississippi. Recently, many have started to fill in with vegetation and sediments, and water conveyance is low. Water flow could be improved with maintenance dredging in selected reaches using a hydraulic pipeline, dragline, or clamshell dredge. Dredged material would be placed along the bank or at previously approved disposal areas.

Proposed dredging, disposal of material, and related activities could negatively affect freshwater mussels (Family: Unionidae), a resource with economic, ecological, and cultural value. In medium- to large-sized rivers, these organisms usually reach their highest density in shallow water close to shore and outside the navigation channel. They are most common in sand/gravel substratum that is kept relatively free of silt with moderate- to high-velocity water, 0.2 to 0.5 m/sec. Mussels are virtually nonmotile, require a fish host to successfully reproduce, and feed by filtering organic matter out of the water column. Shells of many species were used to make buttons before the advent of plastics; today shells of certain species are used to produce cultured pearls.[1] Williams et al.[2] listed nearly 300 species of freshwater mussels in this country; 71.7 percent were considered to be endangered, threatened, or of special concern.

Purpose and Scope

This report summarizes results of a mussel survey in Cassidy, Hopson, Moore, and Opossum Bayous in northwestern Mississippi in 1999 and 2000. The survey was conducted to search for common and uncommon mussels at locations in the river where either channel maintenance or dredging could be required.

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[1] Fuller, S. L. H. (1974). "Clams and mussels (Mollusca: Bivalvia)." *Pollution ecology of freshwater invertebrates.* C. W. Hart and S. L. H. Fuller, ed., Academic Press, New York, 215-273.

[2] Williams, J. D., Warren, M. L., Jr., Cummings, K. S., Harris, J. L., and Neves, R. J. (1993). "Conservation status of freshwater mussels of the United States and Canada," *Fisheries* 18, 6-22.

2 Study Area and Methods

Study Area

A total of 21 sites were searched for mussels along bayous in northwestern Mississippi. The bayous were in Quitman and Tallahatchie Counties near the towns of Lambert and Tutwiler, MS (Figure 1, Table 1). The northernmost location was in Moore Bayou, which joins Cassidy Bayou and flows south into the Tallahatchie River. Moore and Cassidy Bayous are essentially one continuous water body. Hopson Bayou flows northeast and enters Cassidy Bayou near Highway 3. Opossum Bayou is east of Cassidy Bayou, starts near Lambert, and flows almost due south west of Highway 3. It enters Cassidy Bayou south of its confluence with Hopson Bayou.

The terrain in the project area was flat agricultural land. Deciduous trees were uncommon, and most vegetation (herbaceous and deciduous) was associated with ditches, creeks, and bayous. Cypress trees were common in larger areas of the bayous. Substratum in virtually all streams consisted of silt with virtually no gravel or sand. At the time of the surveys, current was virtually nonexistent (10 cm/sec or less) and depth ranged from several centimeters to slightly more than 1 m.

Methods

Sample sites were chosen along the bayous to give as much coverage as possible to the study area. Virtually every area along the bayou with good access was searched for mussels. The majority of the sampling was qualitative. Four individuals waded through the sample sites collecting every mussel encountered by touch or observed underwater. Typically most mussels were collected by feel since visibility was low. The exact amount of time spent collecting at each site was recorded and ranged from 45 to 60 min. A total of 833 min (nearly 14 hr) of search time was expended in 1999 doing qualitative searches of the project area. Mussel taxonomy is consistent with Williams et al.[1]

[1] Williams et al. op. cit.

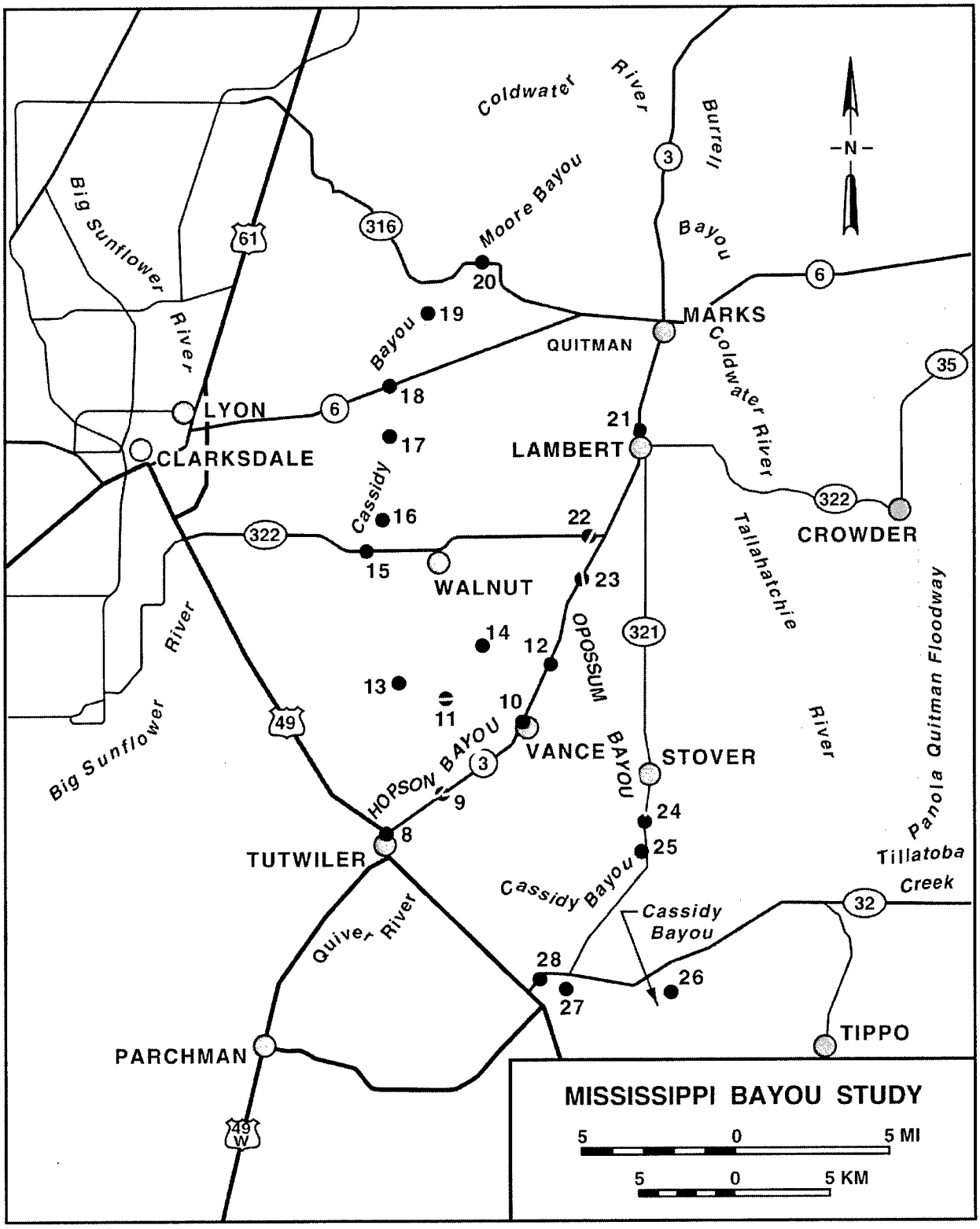

Figure 1. Map of the study area

Table 1
Location of Sample sites for the Mollusc Survey, Northwestern Mississippi Bayous

Date	Waypoint	Bayou	Site	Longitude		Latitude	
				Deg	Min	Deg	Min
May 26, 1999	8	Hopson	1	34	1.186	90	25.867
	9	Hopson	2	34	2.344	90	23.895
	10	Hopson	3	34	4.375	90	21.129
	11	Cassidy	2A	34	5.020	90	23.694
	12	Cassidy	1	34	5.539	90	20.418
	13	Cassidy	2B	34	5.453	90	25.320
	14	Cassidy	2	34	6.478	90	22.483
	15	Cassidy	3	34	9.197	90	26.466
	16	Cassidy	4	34	10.115	90	25.876
	17	Cassidy	5	34	12.504	90	25.598
	18	Cassidy	6	34	13.853	90	25.604
	19	Moore	1	34	15.878	90	24.435
	20	Moore	2	34	17.280	90	22.439
May 27, 1999	21	Opossum	1	34	12.586	90	17.193
	22	Opossum	1A	34	9.659	90	18.818
	23	Opossum	2	34	8.424	90	19.037
	24	Opossum	3	34	1.487	90	16.888
	25	Cassidy	7	34	0.641	90	17.033
	26	Cassidy	8	33	56.673	90	16.020
	27	Cassidy	9	33	56.732	90	19.625
	28	Cassidy	10	33	57.017	90	20.456

In 2000, quantitative samples were obtained at selected sites along Cassidy Bayou (Waypoints 14, 15, and 25). One individual excavated all sand, gravel, and shells from within a 1.0-m^2 aluminum quadrat. Live mussels were identified, their total shell length measured, then they were returned to the water unharmed.

Latitude and longitude were collected at each study area using a hand-held Global Positioning System (Garmin GPS12XL Personal Navigator) (Table 1). Coordinates obtained in the field, in conjunction with information stored in *Street Atlas Version 6.0*,[1] were used to produce maps. Based upon information provided by Garmin, Inc., there can be an error of approximately 6-12 m when using this equipment.

[1] Delorme. (1997). "Street Atlas Version 6.0" (computer program), Yarmouth, ME.

3 Results and Discussion

Existing Conditions

At Moore and Cassidy Bayous a total of 1,014 mussels were collected representing 14 species. A total of 833 min were expended searching for mussels at both locations. Fourteen species were found at Cassidy Bayou, and nine were taken at Moore Bayou (Table 2; Tables A1 and A2, Appendix A). Many more mussels were collected per sampling effort at Cassidy Bayou than at Moore Bayou. Mean collecting rate was 1.38 individuals/min at the former location and 0.26 individual/min at Moore Bayou (Figure 2). No live mussels were collected

Table 2
Percent Abundance and Other Summary Information on Mussels Collected from Moore and Cassidy Bayous, Northwestern Mississippi

Scientific Name	Common Name	Moore Bayou	Cassidy Bayou
Amblema plicata	Threeridge	9.68	61.75
Plectomerus dombeyanus	Bankclimber	6.45	22.48
Quadrula quadrula	Mapleleaf	6.45	5.19
Pyganodon grandis	Giant floater	38.71	2.64
Leptodea fragilis	Fragile papershell	3.23	2.75
Lampsilis teres	Yellow sandshell	6.45	1.42
Potamilus purpuratus	Bleufer	16.13	0.61
Fusconaia flava	Pigtoe		0.81
Ligumia subrostrata	Pondmussel		0.20
Toxolasma parvus	Lilliput	9.68	0.71
Arcidens confragosus	Rock-pocketbook		0.51
Anodonta suborbiculata	Flat floater	3.23	0.10
Uniomerus declivus	Tapered pondhorn		0.51
Megalonaias nervosa	Washboard		0.10
	Total individuals	31	983
	Total species	9	14
	Time, min	120	713
	Individuals collected/min	0.26	1.38

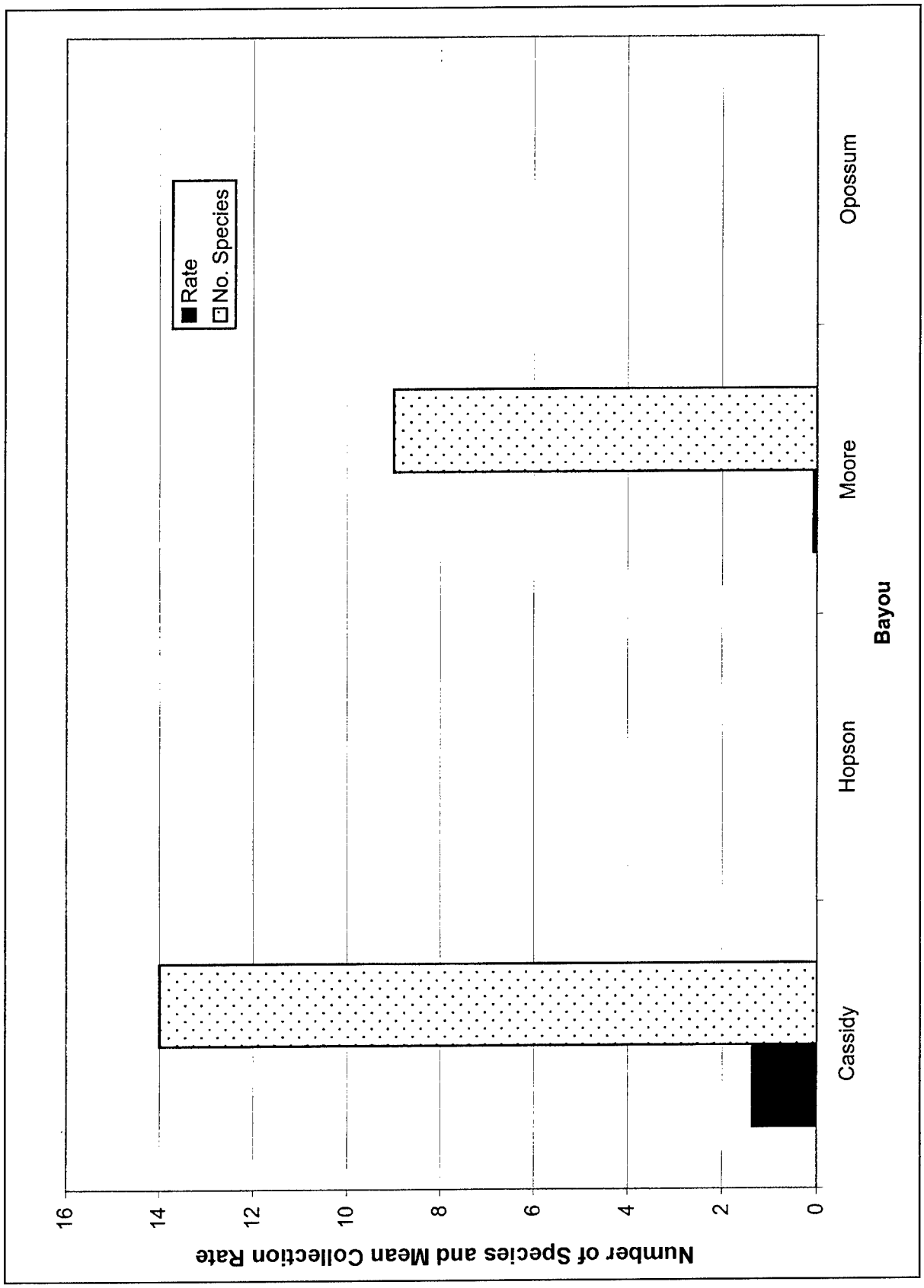

Figure 2. Mussel collecting rate and total number of species collected in four bayous in northwestern Mississippi, 1999

at either Hopson or Opossum Bayou. These water bodies were shallow, and likely some reaches became dry during summer. The substratum consisted mainly of only sand and silt, detritus, and little or no sand and gravel.

The fauna at Moore Bayou was dominated (38.7 percent) by the giant floater, *Pyganodon grandis*, a species common in fine-grained sediments (Table 2). The bleufer, *Potamilus purpuratus*, was second in abundance and composed 16 percent of the fauna. The remaining seven species each composed less than 10 percent of the fauna. All of these species are typically found in fine-grained sediments such as sand and silt. No thick-shelled species, such as those belonging to the genus *Quadrula*, *Megalonaias*, or *Fusconaia*, commonly found in gravel substratum, were collected.

Sites along Cassidy Bayou were dominated by the threeridge, *Amblema plicata,* and the bankclimber, *Plectomerus dombeyanus*; each composed 61.7 and 22.5 percent of the fauna, respectively (Table 2). The remaining 12 species each composed less than 6 percent of the fauna and 8 species were each less than 1 percent of the total collection. The assemblage from Cassidy Bayou was dominated by mussels that can be found in silt and sand as well as gravelly sands. For example, *A. plicata* inhabits silt in ponds and lakes as well as gravelly sands in large rivers. *Plectomerus dombeyanus* typically inhabits fine-grained sediments in southeastern rivers. *Pyganodon grandis*, *Leptodea fragilis*, *Ligumia subrostrata*, and *Uniomerus declivus* are all typically found in fine-grained sediments and systems with low current velocity.

The relationship between the cumulative number of mussel species and cumulative number of individuals collected provides an indication of the difficulty of finding uncommon species. After 600 individuals had been collected, 13 of the 14 species in the project area were found (Figure 3). The first 13 species were collected gradually; all species were not easily found at the first few sites. The last species to be collected, *Megalonaias nervosa*, was extremely uncommon, and was found only at a single site. It was taken after nearly 1,000 individuals were collected.

The relationship between cumulative number of species collected versus the cumulative time expended collecting provides information on the time required to locate very uncommon species (Figure 4). After more than 200 min had been spent searching, virtually all mussel species had been located (13 of 14 species). The last species found, *M. nervosa*, was found after nearly 600 min had been spent searching.

Sample sites along Cassidy and Moore Bayous were arranged according to distance from the mouth of Cassidy Bayou versus the number of species collected and the collecting rate plotted (Figures 5 and 6, respectively). There was little relationship between distance from the mouth of the bayou and number of species collected (Figure 5). However, Figure 6 illustrates that the majority of the mussels (i.e., the highest collecting rate) occurred between Waypoints 25 and 17, the center reach of these two connecting water bodies (Figure 1). The extreme lower reach of Cassidy Bayou, with high sedimentation rates and poor substratum quality, was poor mussel habitat. The extreme upper reach of Cassidy Bayou, as

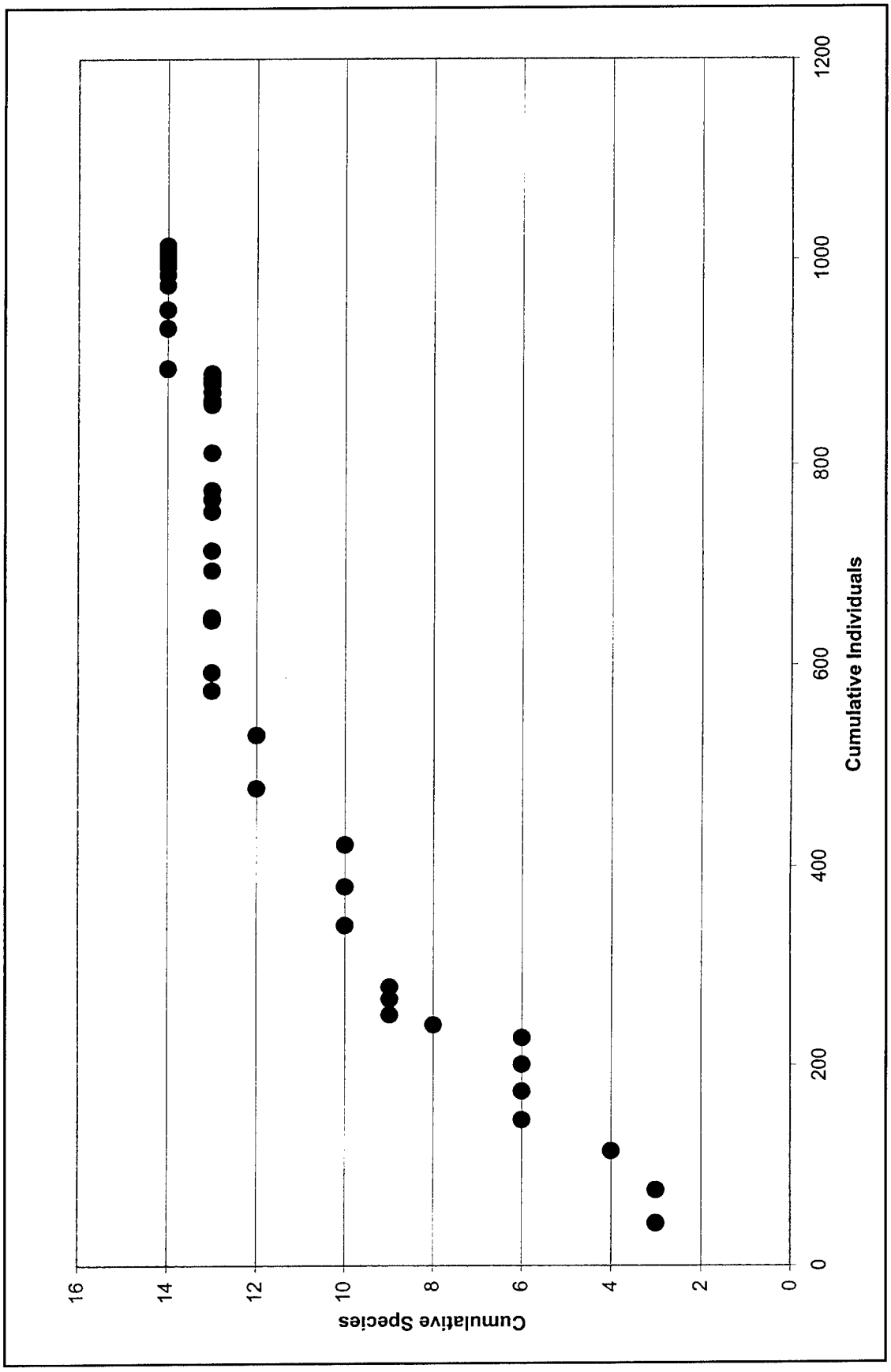

Figure 3. The relationship between cumulative number of species and cumulative number of mussels collected at Cassidy and Moore Bayous, northwestern Mississippi, 1999

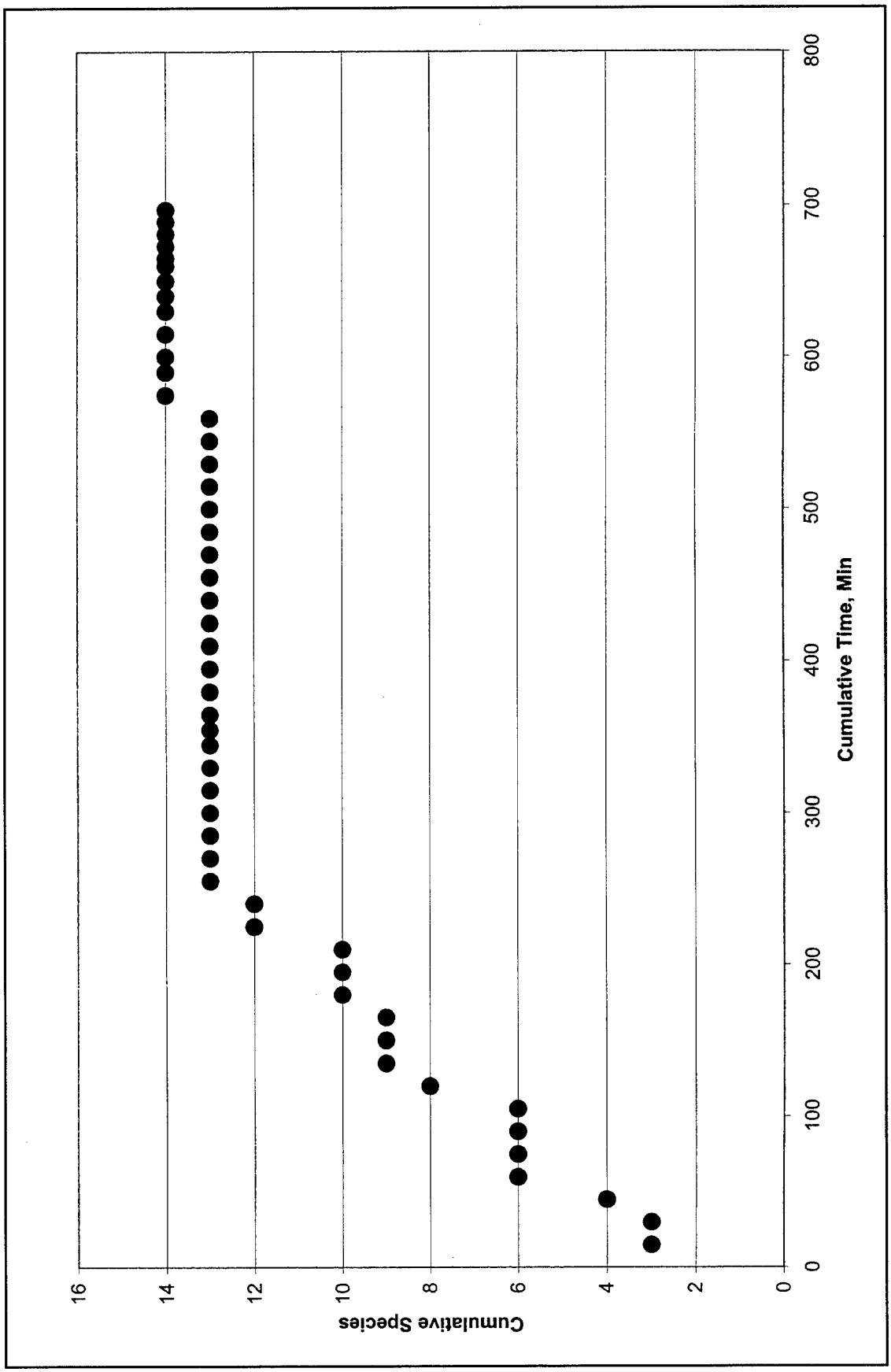

Figure 4. The relationship between cumulative number of species and cumulative number of minutes collecting at Cassidy and Moore Bayous, northwestern Mississippi, 1999

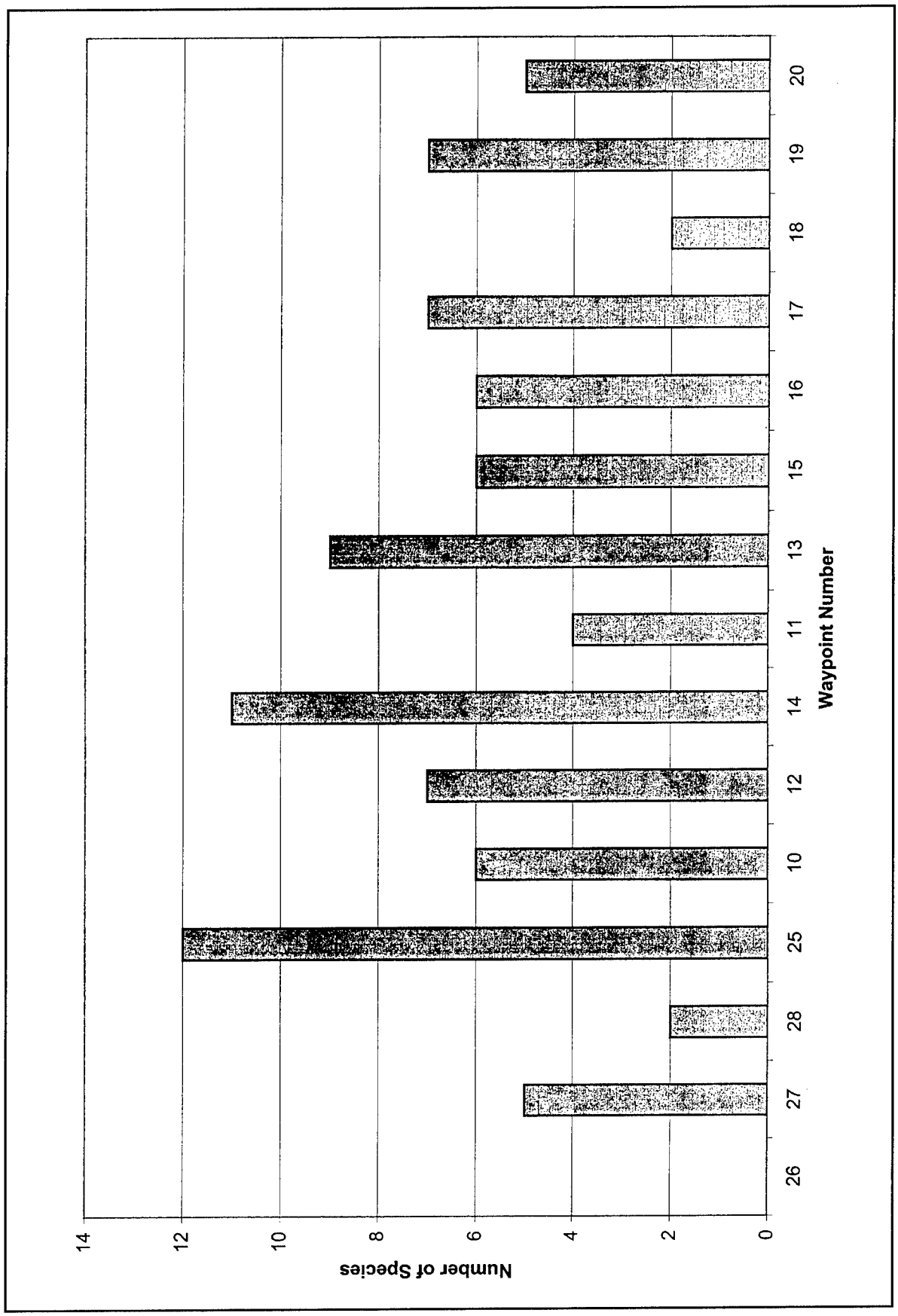

Figure 5. Number of species collected at sites along Cassidy and Moore Bayous. Sites are arranged in order of increasing distance from the mouth of Cassidy Bayou

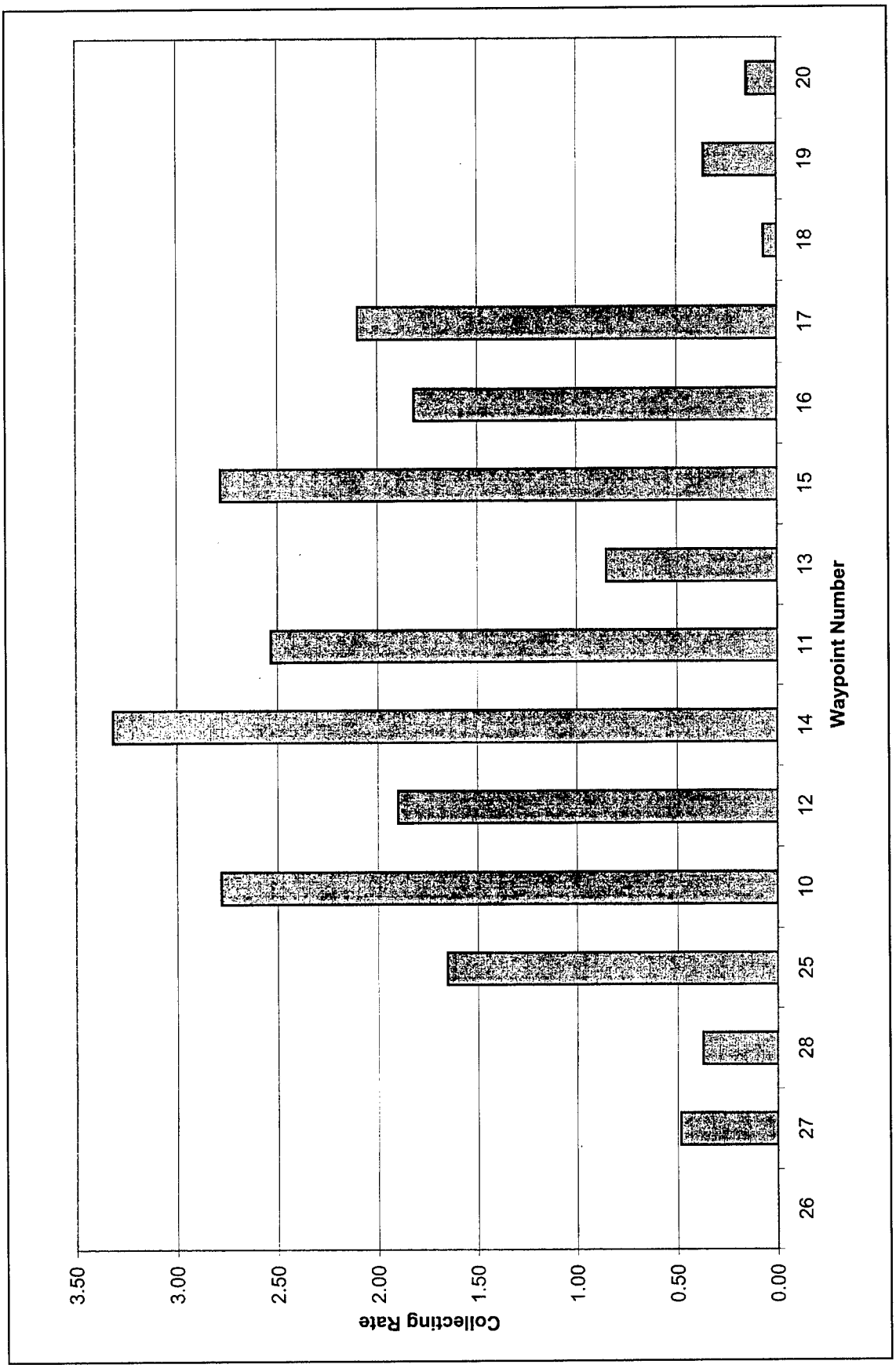

Figure 6. Mussel collecting rate at sites along Cassidy and Moore Bayous. Sites are arranged in order of increasing distance from the mouth of Cassidy Bayou

well as all of Moore Bayou, was shallow and also provided poor mussel habitat. It is likely that some of these upriver reaches became dry during the summer, which would have eliminated the mussels. An evaluation of the number of species collected, plus collecting rate, can be used to value each of the sites along both bayous (Table 3).

Table 3
Summary Information on the Northwest Mississippi Bayou Study

Waypoint	Bayou	Total Species	Collecting Rate	Value for Mussels
8	Hopson	0	0.00	Low
9	Hopson	0	0.00	Low
10	Hopson	0	0.00	Low
11	Cassidy	4	2.53	High
12	Cassidy	7	1.90	High
13	Cassidy	9	0.85	High
14	Cassidy	11	3.32	High
15	Cassidy	6	2.78	High
16	Cassidy	6	1.82	High
17	Cassidy	7	2.10	High
18	Cassidy	2	0.07	Moderate
19	Moore	7	0.37	Moderate
20	Moore	5	0.15	Moderate
21	Opossum	0	0.00	Low
22	Opossum	0	0.00	Low
23	Opossum	0	0.00	Low
24	Opossum	0	0.00	Low
25	Cassidy	11	1.65	High
26	Cassidy	0	0.00	Low
27	Cassidy	5	0.49	Moderate
28	Cassidy	2	0.38	Moderate

Density and Community Composition

Average density of mussels at the four sites ranged from 2.6 to 16.8 individuals per square meter (Table 4), based upon quantitative sampling conducted in July 2000. Quantitative samples were taken at nearshore and farshore locations at Waypoint 25 and at a single location at Waypoints 14 and 15. A total of nine species were collected in these quadrat samples. The dominant species, *A. plicata*, composed 73.3 percent of the community. *Plectomerus dombeyanus* was common, composing 11.1 percent of the community. *Pyganodon grandis* (4.4 percent), *Lampsilis teres* (3.3 percent), *L. fragilis* (3.3 percent), and *Quadrula quadrula* were uncommon. *Potamilus purpuratus*, *Toxolasma parvus*, and *Fusconaia flava* were uncommon (0.5 to 1.1 percent of the total). No small

Table 4
Results of Quantitative Sampling (1 sq m) at Four Locations in Northwest Mississippi, 2000

Species	Number of Individuals Collected	% Abundance	
A. plicata	132	73.33	
P. grandis	8	4.44	
T. parvus	1	0.56	
F. flava	1	0.56	
L. teres	6	3.33	
L. fragilis	6	3.33	
P. dombeyanus	20	11.11	
P. purpuratus	2	1.11	
Q. quadrula	4	2.22	
Total individuals	180		
Total species	9		
% Individuals < 30 mm	0		
% Species < 30 mm	0		
Waypoint	**Number of Mussels**	**Density Individuals/m^2**	**Standard Deviation**
25 (Far shore)	26	2.6	2.1
25 (Nearshore)	41	5.1	2.7
14	84	16.8	5.9
15	29	5.8	4.4
Overall	180	6.4	6.1

mussels (less than 30 mm total shell length) were collected indicating that recruitment was extremely low. It is likely that there are some juveniles in these bayous; however, their numbers are so low it is difficult to find them.

Amblema plicata

Size distribution analysis indicated a population heavily dominated by mussels ranging from 100 to 140 mm long (Figure 7). Median length was 120 mm. Minimum and maximum lengths were 51 and 170 mm, respectively. Seven of 132 individuals ranged from 52 to 98 mm long, but only one individual greater than 136 mm was obtained. Thus, the size distribution included more medium-sized and small individuals than large individuals. Size structure is consistent with decreased rate of length increase with increasing age and size, high longevity, and occasional recruitment of young mussels to this population.

Inflation of mussels was linearly related to length (Figure 8). The slope of this relationship (0.46) indicated approximately a 10-mm increase in inflation for each

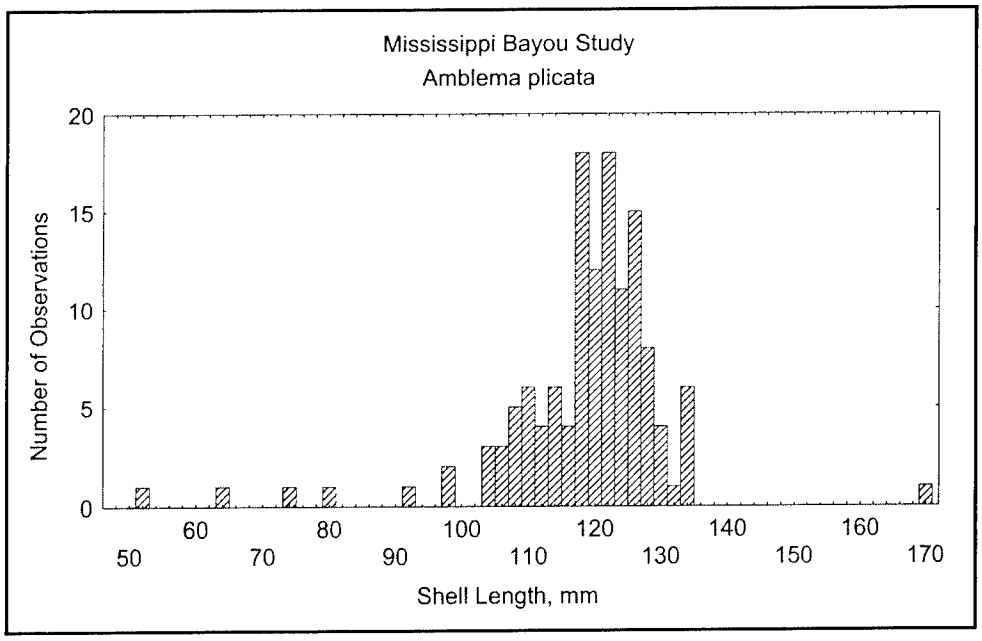

Figure 7. Shell length frequency histogram of *A. plicata* collected at four sites in Cassidy Bayou, 2000

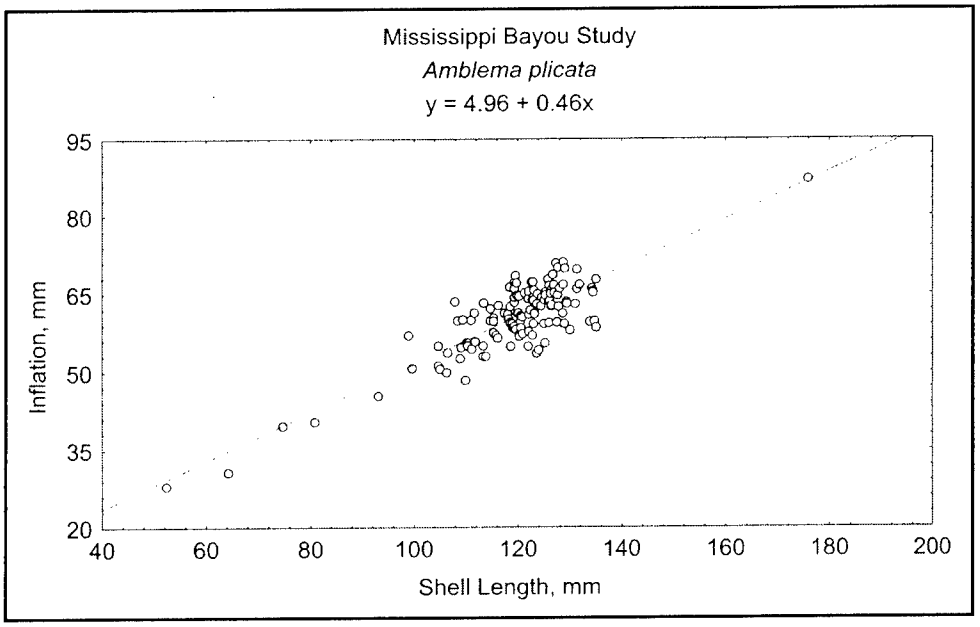

Figure 8. Relation between shell inflation and shell length for *A. plicata* collected at four sites in Cassidy Bayou, 2000

20-mm increase in length. Despite this linear relationship, considerable scatter was evident among the most abundant length classes. Mussels ranging in length from 100 to 140 mm ranged in inflation from 47 to 71 mm. Inflation-to-length ratios ranged among individuals from 0.43 to 0.59. The height-to-length relationship was linear, with a slope of 0.64 (Figure 9). The average height-to-length ratio equaled 0.70, with individual ratios ranging from 0.60 to 0.80.

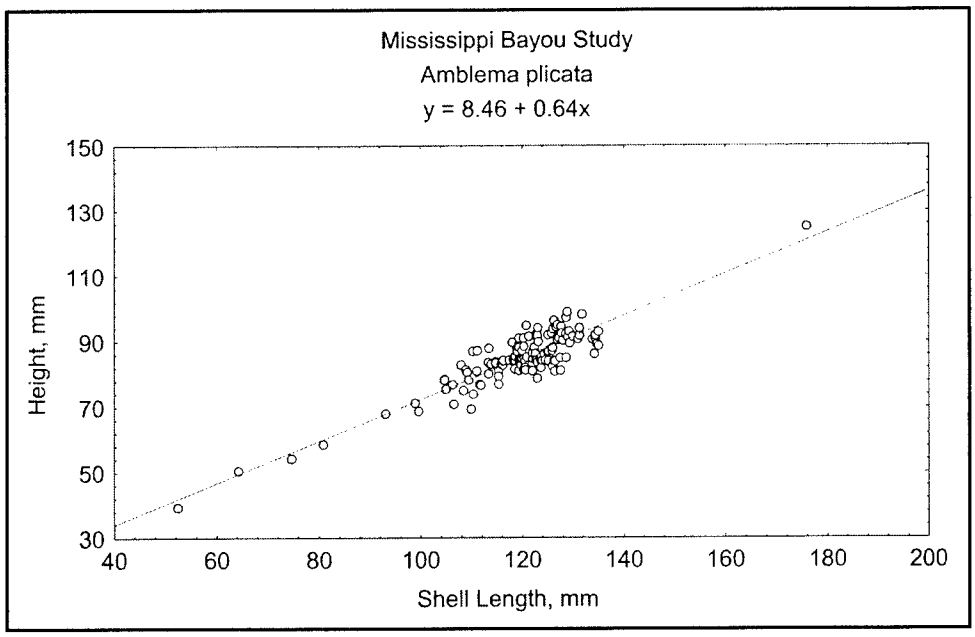

Figure 9. Relation between shell height and shell length for *A. plicata* collected at four sites in Cassidy Bayou, 2000

The logarithm of total wet weight of *A. plicata* was a linear function of shell length (Figure 10). Weight ranged from approximately 1.5 to 3.1 kg, with most mussels (those 100 to 140 mm long) falling within a weight range of 2.4 to 2.8 kg. Typically, the logarithm of weight is a linear function of the logarithm of length. The relatively narrow total range of lengths in this sample allowed a semilogarithmic relationship to provide a reasonable fit.

Plectomerus dombeyanus

A total of only 20 individuals of this species was obtained. The size distribution was similar to that of *A. plicata* in that most of the population comprised large mussels, and distribution favored smaller rather than median-sized individuals (Figure 11). Once again this structure is consistent with decreased rate of length increase with increasing age and size, high longevity, and only occasional and minor recruitment. Median length was 132 mm; maximum and minimum lengths were 148 and 80 mm, respectively. This range is probably a conservative estimate for the population due to the relatively small sample size.

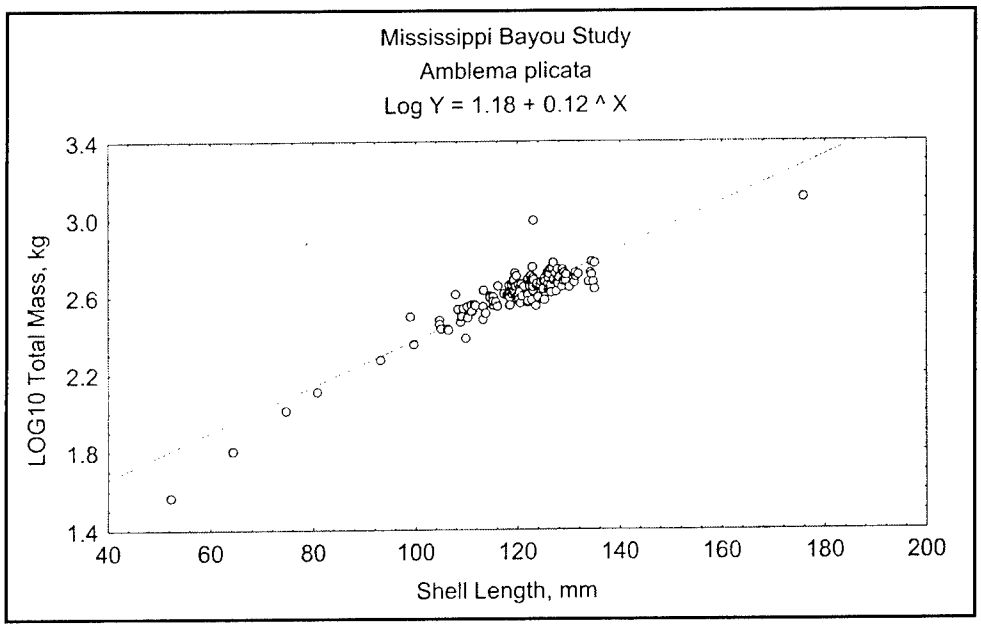

Figure 10. Relation between the logarithm (to the base 10) of total mass and the shell length of *A. plicata* at four sites in Cassidy Bayou, 2000

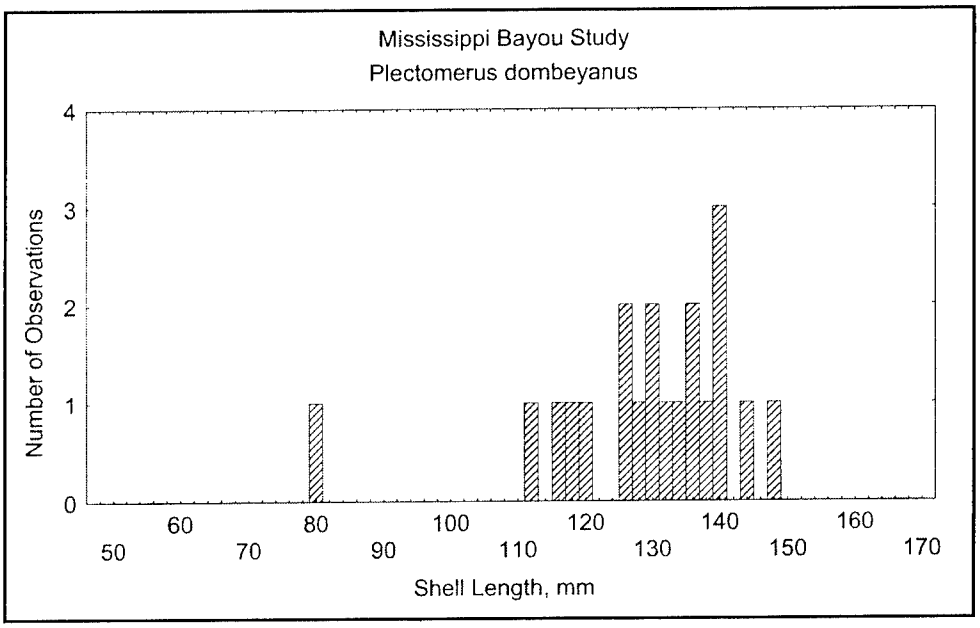

Figure 11. Shell length frequency histogram of *P. dombeyanus* collected at four sites in Cassidy Bayou, 2000

4 Summary and Conclusions

Quantitative and qualitative collections in Cassidy, Moore, Hopson, and Opossum Bayous in 1999 and 2000 yielded 14 species of native mussels. No federally listed endangered or threatened mussels were collected. Slightly more than 1,000 live mussels were taken from Moore and Cassidy Bayous; no live mussels were collected in Hopson and Opossum Bayous. These latter bayous were characterized by shallow water and poor quality substratum consisting mainly of organic matter, with little or no sand and gravel. The mussel fauna in Moore Bayou was dominated by *P. grandis* and *P. purpuratus*, two species common in fine-grained sediments. The fauna in Cassidy Bayou was dominated by *A. plicata* and *P. dombeyanus*, two species that are abundant throughout the south and are common in streams, ponds, and bayous. Average densities were low, less than 16.8 individuals/sq m. Although no evidence of recent recruitment was found during this survey, it is likely that juveniles are present although in extremely low numbers.

Dredging will locally impact the mussels in reaches where channel maintenance will be required. All of these mussels will be lost. In addition, dredging will have secondary effects that could include elevated suspended sediments and associated decreased water quality. However, dredging could provide long-term benefits to Cassidy and Moore Bayous by removing settled sediments and deposited organic matter. Reducing the cross-sectional area of the water body could increase current velocities in the affected reach. Removal of sand and silt will provide a higher quality habitat that could be colonized by mussels and other invertebrates once the effects of dredging are over.

Appendix A
Results of Timed Searches for Mussels, June 1999

Table A1
Percent Abundance and Other Summary Information on Mussels Collected from Moore Bayou, Northwestern Mississippi

Species	Waypoint 19 Site 1	Waypoint 20 Site 2	Total
A. plicata	13.64	0.00	9.68
P. dombeyanus	9.09	0.00	6.45
Q. quadrula	9.09	0.00	6.45
P. grandis	45.45	22.22	38.71
L. fragilis	4.55	0.00	3.23
L. teres	4.55	11.11	6.45
P. purpuratus	13.64	22.22	16.13
T. parvus	0.00	33.33	9.68
A. suborbiculata	0.00	11.11	3.23
Total individuals	22	9	31
Total species	7	5	9
Time, min	60	60	120
Individuals/min	0.37	0.15	0.26

Table A2
Percent Abundance and Other Summary Information on Freshwater Mussels, Collected from Cassidy Bayou, Northwestern Mississippi

Species	11 2A	12 1	13 2B	14 2	15 3	16 4	17 5	18 6	25 7	26 8	27 9	28 10	Total
A. plicata	83.33	47.37	58.82	27.64	73.65	73.39	86.67	75.00	68.13	0.00	52.94	41.67	61.75
P. dombeyanus	13.16	28.07	7.84	55.78	16.17	18.35	0.95	25.00	3.30	0.00	0.00	58.33	22.48
Q. quadrula	2.63	10.53	9.80	2.01	6.59	0.92	3.81	0.00	7.69	0.00	23.53	0.00	5.19
P. grandis	0.88	2.63	7.84	2.01	0.00	2.75	2.86	0.00	6.59	0.00	11.76	0.00	2.64
L. fragilis	0.00	4.39	7.84	4.52	1.80	0.00	2.86	0.00	3.30	0.00	0.00	0.00	2.75
L. teres	0.00	1.75	1.96	3.02	0.00	2.75	0.00	0.00	2.20	0.00	0.00	0.00	1.42
P. purpuratus	0.00	0.00	0.00	0.00	0.60	0.00	1.90	0.00	3.30	0.00	0.00	0.00	0.61
F. flava	0.00	5.26	0.00	0.50	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.81
L. subrostrata	0.00	0.00	1.96	0.00	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.20
T. parvus	0.00	0.00	1.96	1.01	0.00	1.83	0.00	0.00	1.10	0.00	5.88	0.00	0.71
A. confragosus	0.00	0.00	0.00	1.01	1.20	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.51
A. suborbiculata	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.88	0.00	0.10
U. declivus	0.00	0.00	1.96	2.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51
M. nervosa	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	1.10	0.00	0.00	0.00	0.10
Total individuals	114	114	51	199	167	109	105	4	91	0	17	12	983
Total species	4	7	9	11	6	6	7	2	11	0	5	2	14
Time, min	45	60	60	60	60	60	50	60	55	0	35	32	713
Individuals/min	2.53	1.90	0.85	3.32	2.78	1.82	2.10	0.07	1.65	0	0.49	0.38	1.38

Note: Data for each species are given by waypoint and corresponding site.

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14. ABSTRACT

Freshwater mussels (Family: Unionidae) were collected at four bayous (Moore, Cassidy, Hopson, and Opossum) in northwestern Mississippi in 1999 and 2000. The purpose was to assess habitats likely to be impacted by maintenance dredging required to improve water conveyance. Fourteen native mussel species were found at Cassidy Bayou and nine were taken at Moore Bayou; none were collected in either of the other two bayous. Many more mussels were collected per sampling effort at Cassidy Bayou than at Moore Bayou. Collecting rate was 1.38 live mussels/min at Cassidy Bayou and 0.26 mussel/min at Moore Bayou. Average total density at four sites in Cassidy Bayou ranged from 2.8 to 16.8 individuals/sq m. No evidence of recent recruitment was found in any of the quantitative samples; all individuals and species were greater than 30 mm total shell length. All mussel species collected from these bayous were common in silt-sand substratum with low water velocity (typically 0 to 0.25 m/sec during normal and low flow). Sites along Cassidy Bayou were dominated by the threeridge, *Amblema plicata,* and the bankclimber, *Plectomerus dombeyanus*, which each composed 61.7 and 22.5 percent of the fauna, respectively. The fauna at Moore Bayou was dominated by the giant floater, *Pyganodon grandis* (38.7 percent),
(Continued)

15. SUBJECT TERMS

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14. ABSTRACT (Concluded)

and the bleufer, *Potamilus purpuratus* (16 percent). The remaining seven species each composed less than 10 percent of the fauna.

Dredging will locally impact the mussels in reaches where channel maintenance will be required. However, both Cassidy and Moore Bayous could be improved if dredging results in increased water velocity, which will remove settled sediments and organic matter deposited during low flow.